Cooperative learning contexts in upper secondary analytic geometry lessons using DGS

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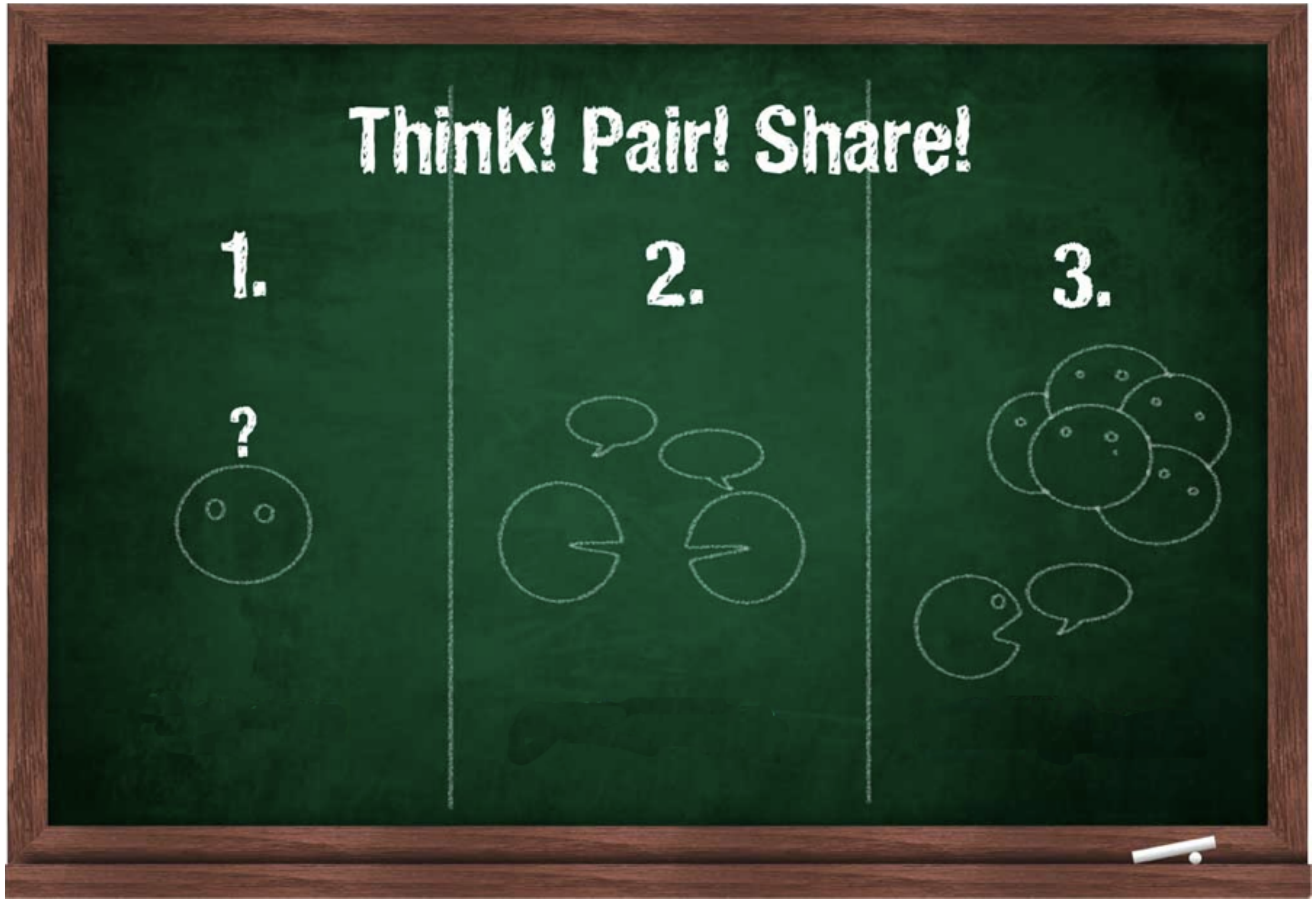
- Can methods of Cooperative Learning in the sequence Think - Pair - Share have a positive effect on a senseful application of digital tools?
- Is there an advantage in using cooperative structures in the coherence of applying DGS?
- What are thinkable constellations?

Cooperative Learning Contexts

Cooperative Learning Contexts



- Cooperative learning concept in the sense of Green/ Green (2005)

Cooperative Learning Contexts

Instructional strategy simultaneously addressing academic and social skill learning by students.

Positive Interdependency Theory: Johnson/Johnson (1998)

Cooperative Learning Contexts

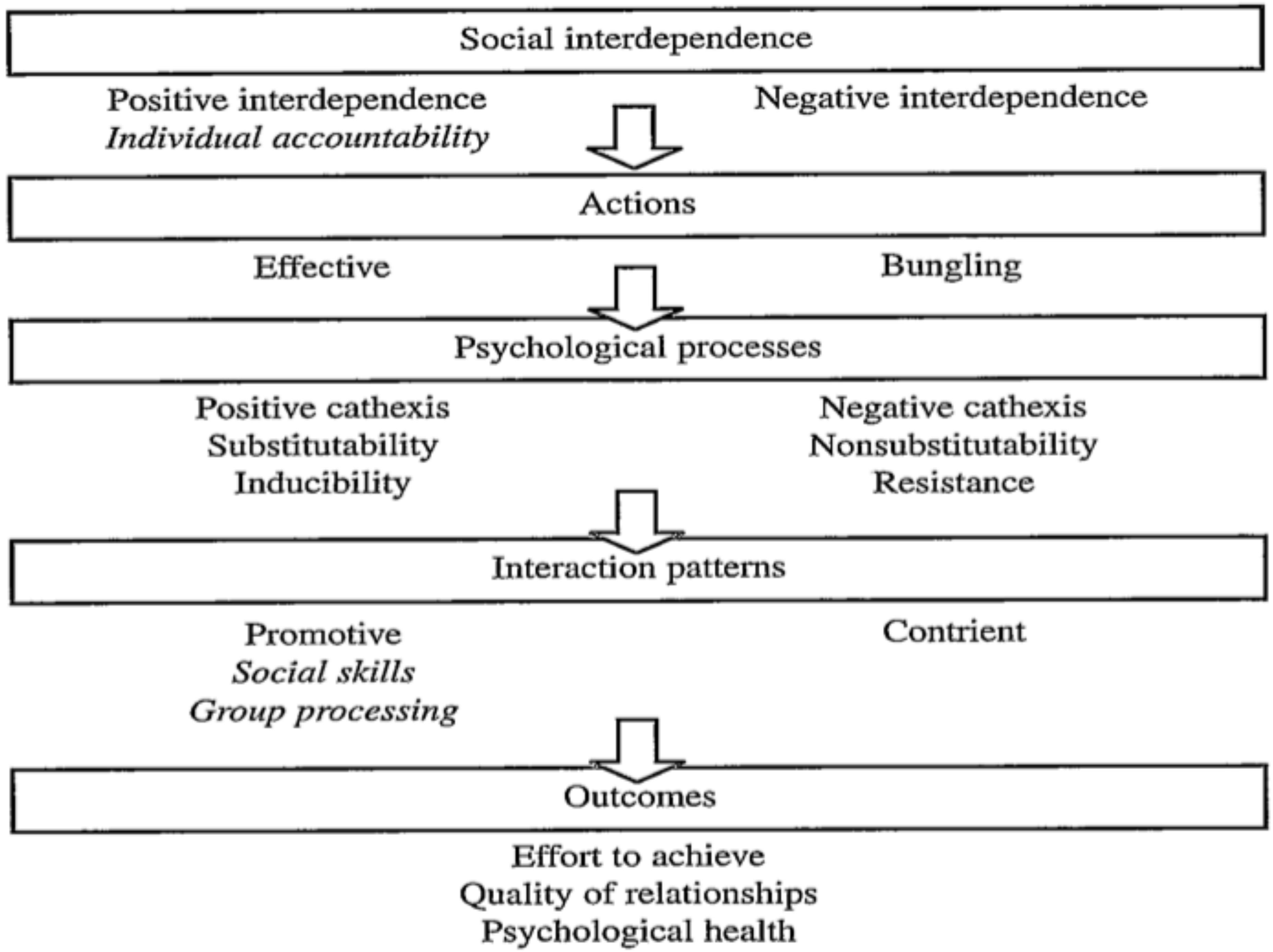
"Positive interdependence is linking students together so one cannot succeed unless all group members succeed. Group members have to know that they sink or swim together." (Johnson, Johnson, & Holubec, 1998, p. 4:7).

Cooperative Learning Contexts

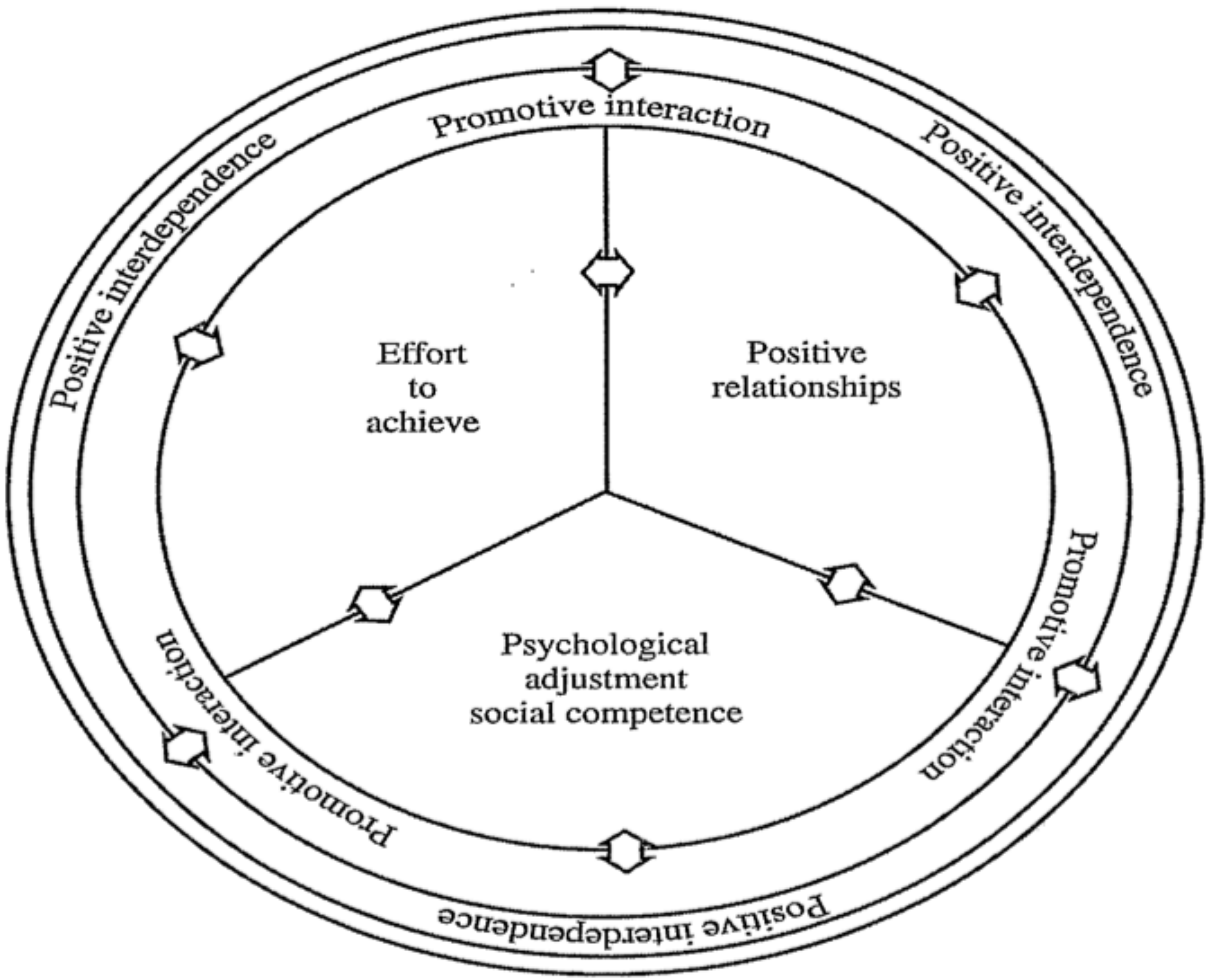
"When students clearly understand positive interdependence, they understand that each group member's efforts are required and indispensable for group success and that each group member has a unique contribution to make to the joint effort because of his or her resources and/or role and task responsibilities" (Johnson, Johnson, & Holubec 1998).

Positive goal interdependence ensures that the group is united around a common goal, a concrete reason for being, such as "learning the assigned material and making sure that all other members of your group learn the assigned material" (Johnson, Johnson and Holubec, 1998, p. 4:8).

Cooperative Learning Contexts



Cooperative Learning Contexts



Cooperative Learning Contexts

Cooperative Learning is one way of providing students with a well defined framework from which to learn from each other. Students work towards fulfilling academic and social skill goals that are clearly stated. It is a team approach where the success of the group depends upon everyone pulling his or her weight.

Application: Upper Secondary Analytical Geometry

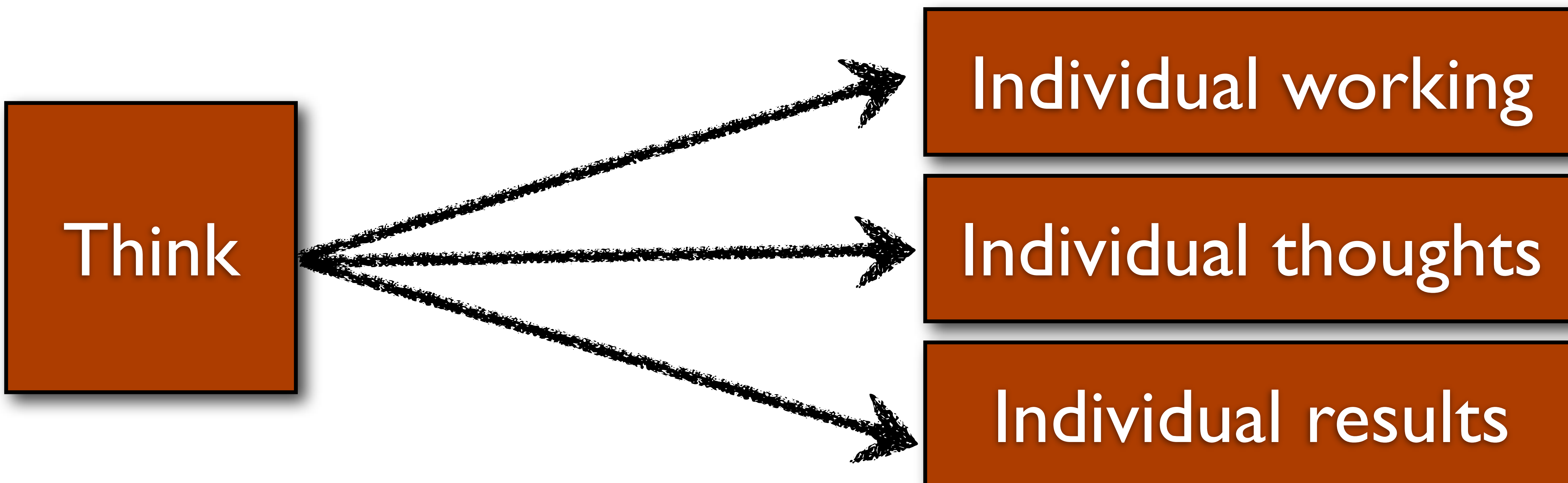
Cooperative Learning is an effective way of pupil centered active learning, but it must be used in a sense-full way and then the teaching planed very well.

Teaching methods and tools must be applied in a serious and sense-full way with reasonable aims.

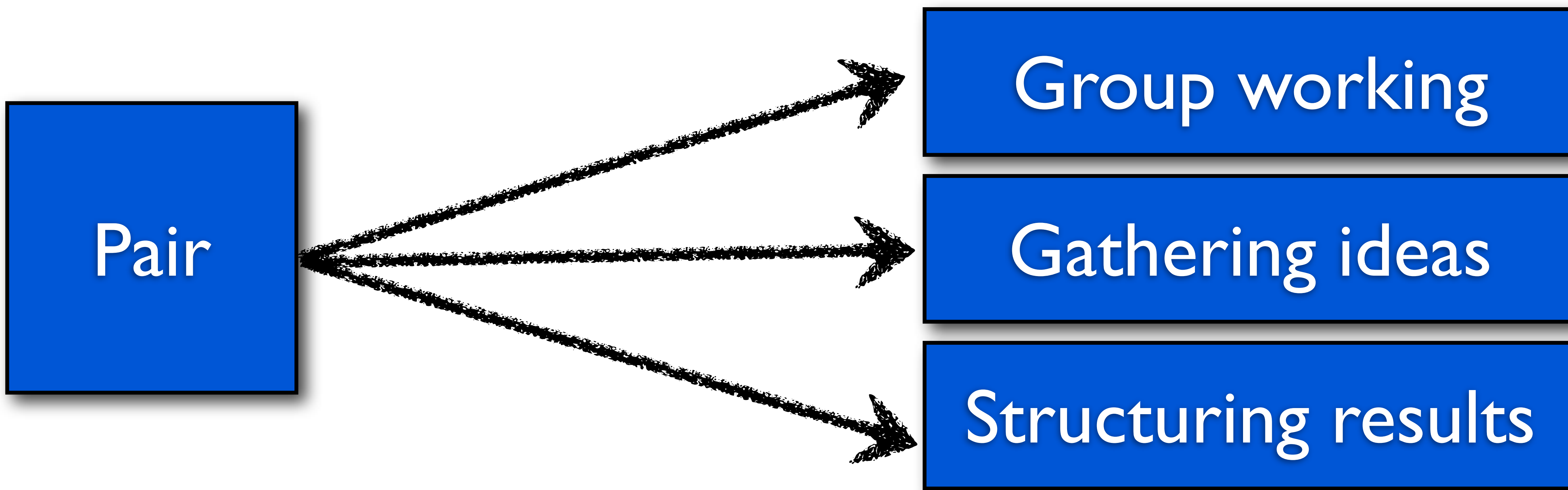
Five Basic Elements of Cooperative Learning

- 1. Positive Interdependence
- 2. Face-To-Face Interaction
- 3. Individual Accountability
- 4. Social Skills
- 5. Group Processing

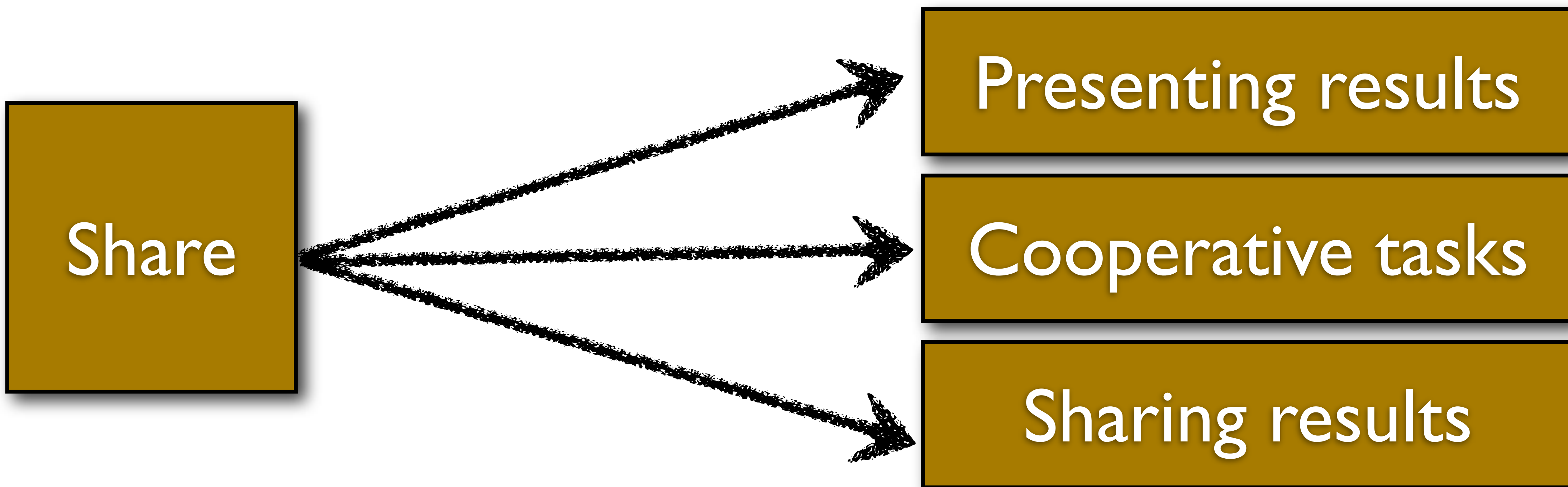
Cooperative Learning needs individual working phases



Cooperative Learning Phase



Cooperative Presentation Phase



Cooperative Learning Contexts

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Think			
Pair	Pair with partner	Pair with group	Pair using interviews
Share	Share own group	Share other groups	Share whole group

Cooperative Learning Contexts

K1: Mathematical argumenting

K2: Solve problems mathematically

K3: Mathematical modeling

K4: Use mathematical representations

K5: Dealing wit symblic, formal and technical elements of mathematics

K5: Communicate

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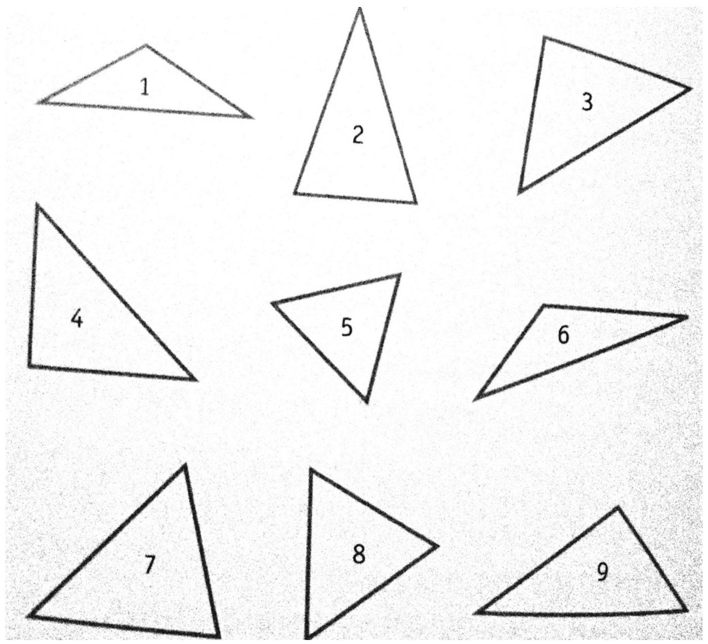
Example in Maths education

	acute-angeled	right-angeled	obtuse-angeled
equilateral			
isosceles non equilateral			
asymmetric			



Brüning, Saum (2009)

DGS and Cooperative Learning

DGS and Cooperative Learning

DGS is a (powerful) tool for working with mathematics but like every tool, there must be a serious reason for using it and a sense-full way of application.

DGS and Cooperative Learning

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Role of DGS

Static representation of algebraic and geometric coherences

Dynamic representation of algebraic and geometric coherences also in respect to versatile thinking

Presenting the results

Control

„Thinking tool“

inter alia Roth (2008)

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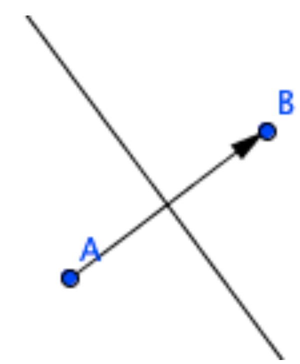
DGS Characteristics and functions

Geometric representation

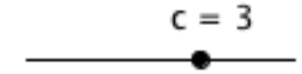
Algebraic representation

Dynamic representation



Freie Objekte
- A = (1.32, 2.04)
- B = (2.8, 3.14)
- c = 3

Abhängige Objekte
- C = (5.76, 5.34)
- a: −1.48x − 1.1y = −5.9
- $u = \begin{pmatrix} 1.48 \\ 1.1 \end{pmatrix}$



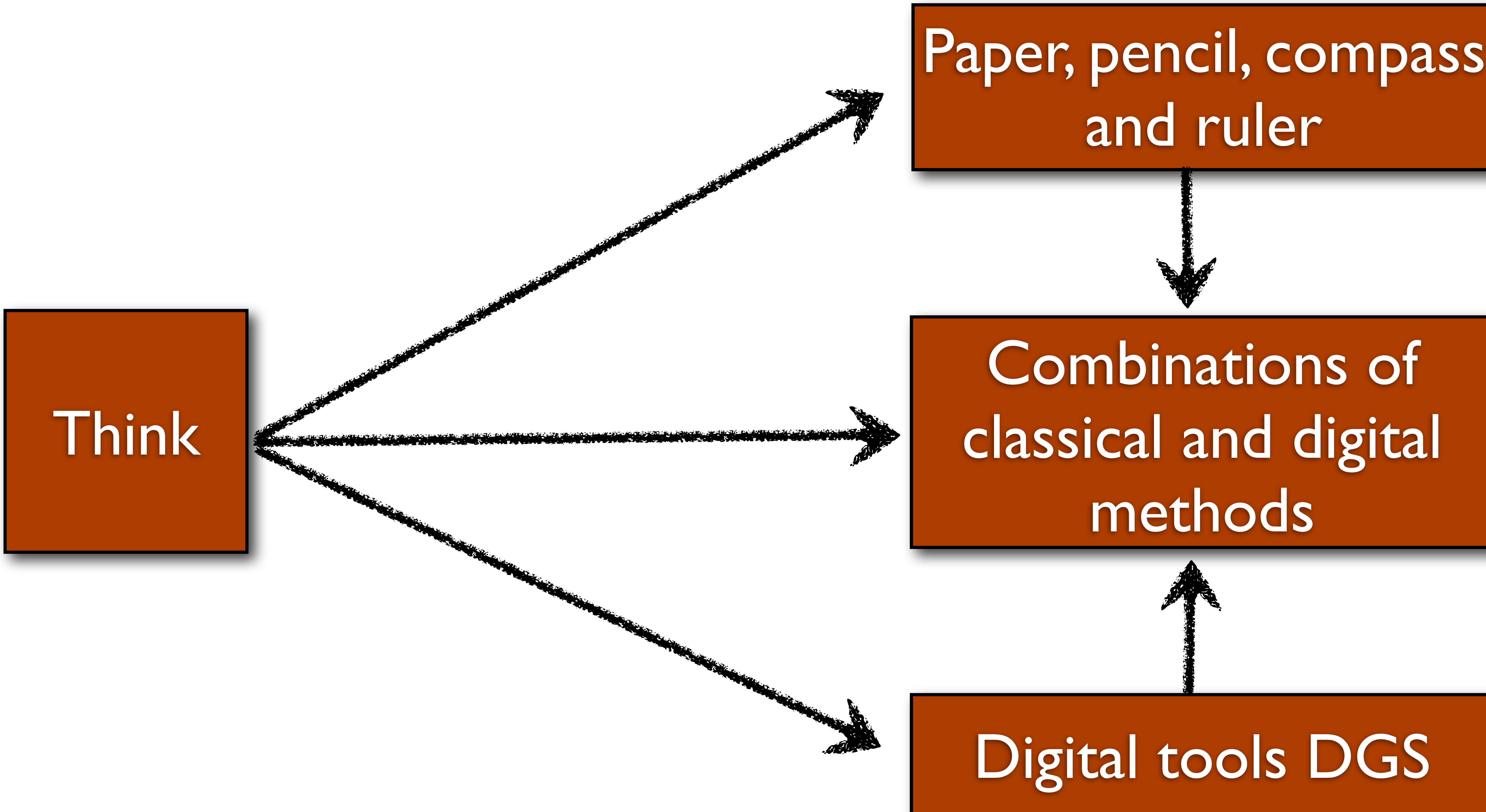
DGS and Cooperative Learning

Thesis: Structuring the cooperative usage of DGS in the three steps T - P - S can lead to deeper cognitive operation level.

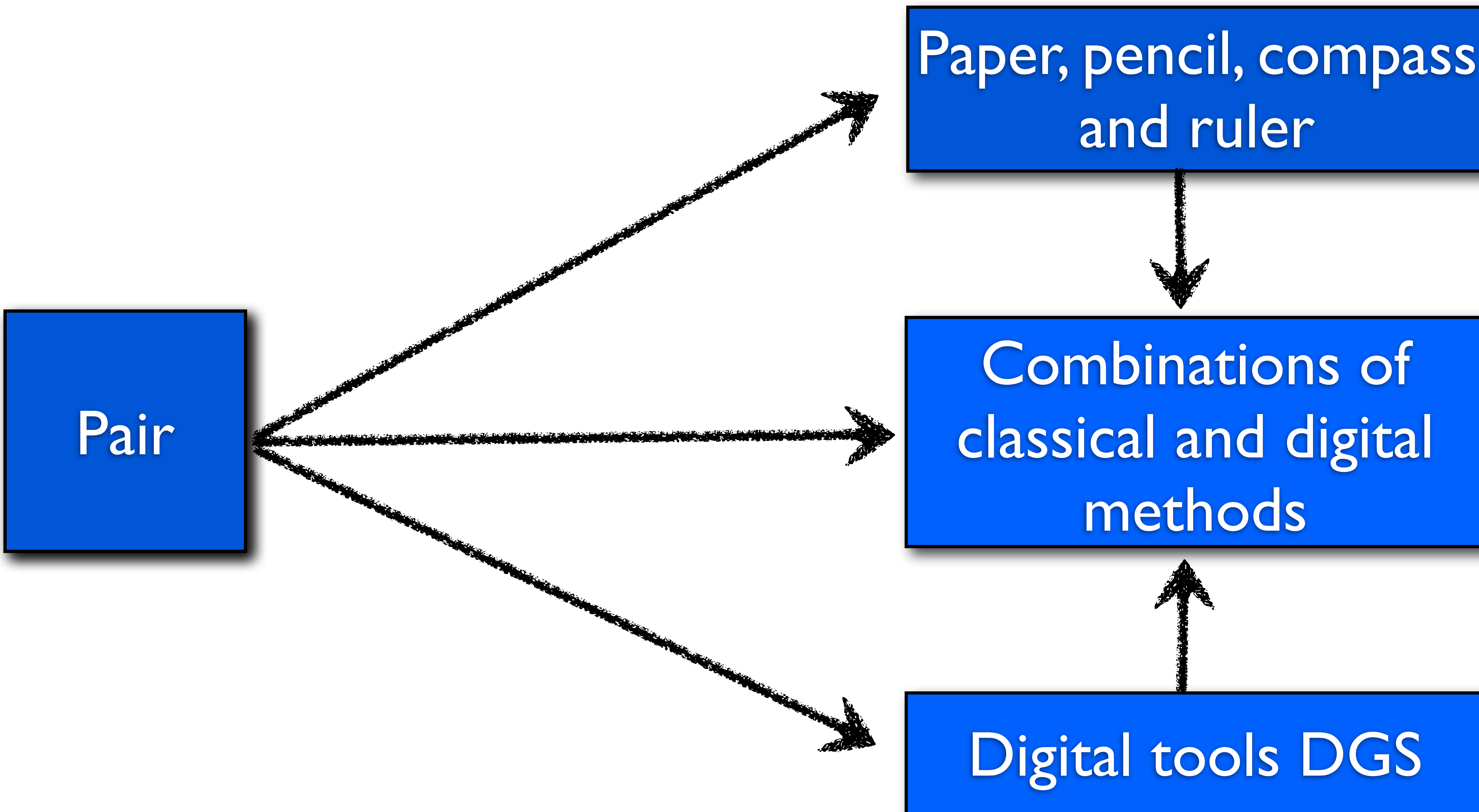
Prerequisites:

- Adequate working materials and tasks for every step
- Competencies in using DGS
- Experiences in Cooperative Learning

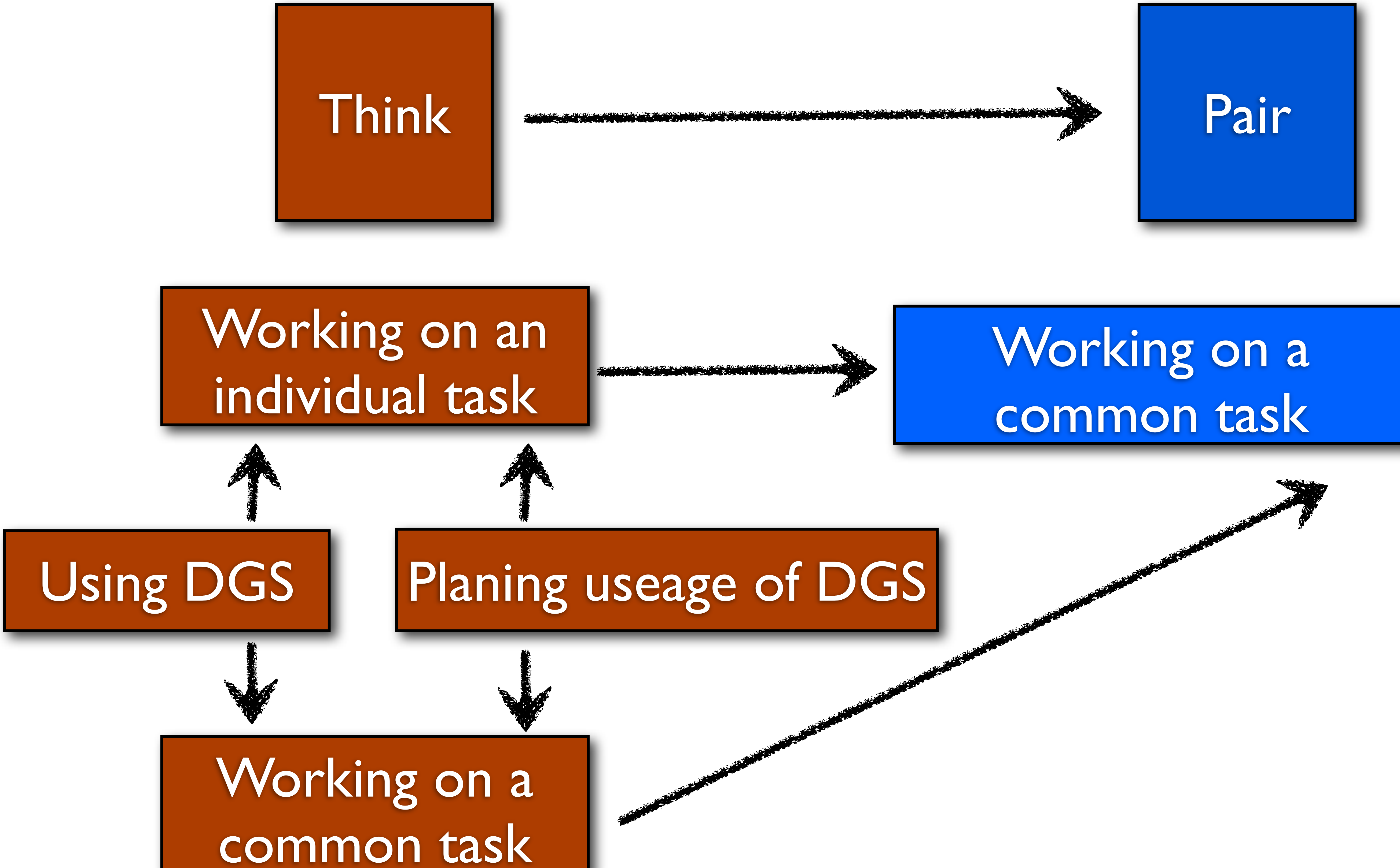
DGS and Cooperative Learning



DGS and Cooperative Learning



DGS and Cooperative Learning



Application: Upper Secondary Analytical Geometry

Central ideas of Analytic Geometry:

- Algebraic description of the euclidian space
- Geometric description of algebraic equations
  - Three-dimensional to flat
  - Coordinates
  - Parameters
  - Vectors
- Study geometric Objects (Curves, Surfaces, Solids)
- Collinearity and coplanarity
- Inner product and applications

Wittmann (2003)

Aims of teaching mathematics in general:

- Algorithmic knowledge
- Concept knowledge
- Flexible use of algorithms and concepts
- Ability of problem solving and modeling

Task (Reactivation of Matrix multiplication):

Matrices can describe mappings. Have a look at the following situation and calculate the result of the mapping on your own.

$$A \cdot v$$

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, v = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

Application: Upper Secondary Analytical Geometry

Now matrices should be used for the description of geometric mappings.

Application: Upper Secondary Analytical Geometry

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In the following working phase, the tasks must be worked on in the given structure:

1. Think phase: Work on your own and use the result sheet

2. Pair phase: Work with your partner, use your results and the DGS to solve the problem.

3. Share Phase: Present the results using the DGS.

Every one can be choosen for presentation and every one is responsible to bring suitable results from the think phase to the pair phase to guarantee a successfull work there.

Application: Upper Secondary Analytical Geometry

1. Think phase: Each partner must choose one of the following geometric mappings:

- Reflection
- Translation

1. Note the characteristics of your choosen mapping.

2. Regard three vectors $\begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$ and map the represented point.

3. Find a suitable matrix describing this mapping.
4. Think about which vectors can help you to easily find this matrix.

Application: Upper Secondary Analytical Geometry

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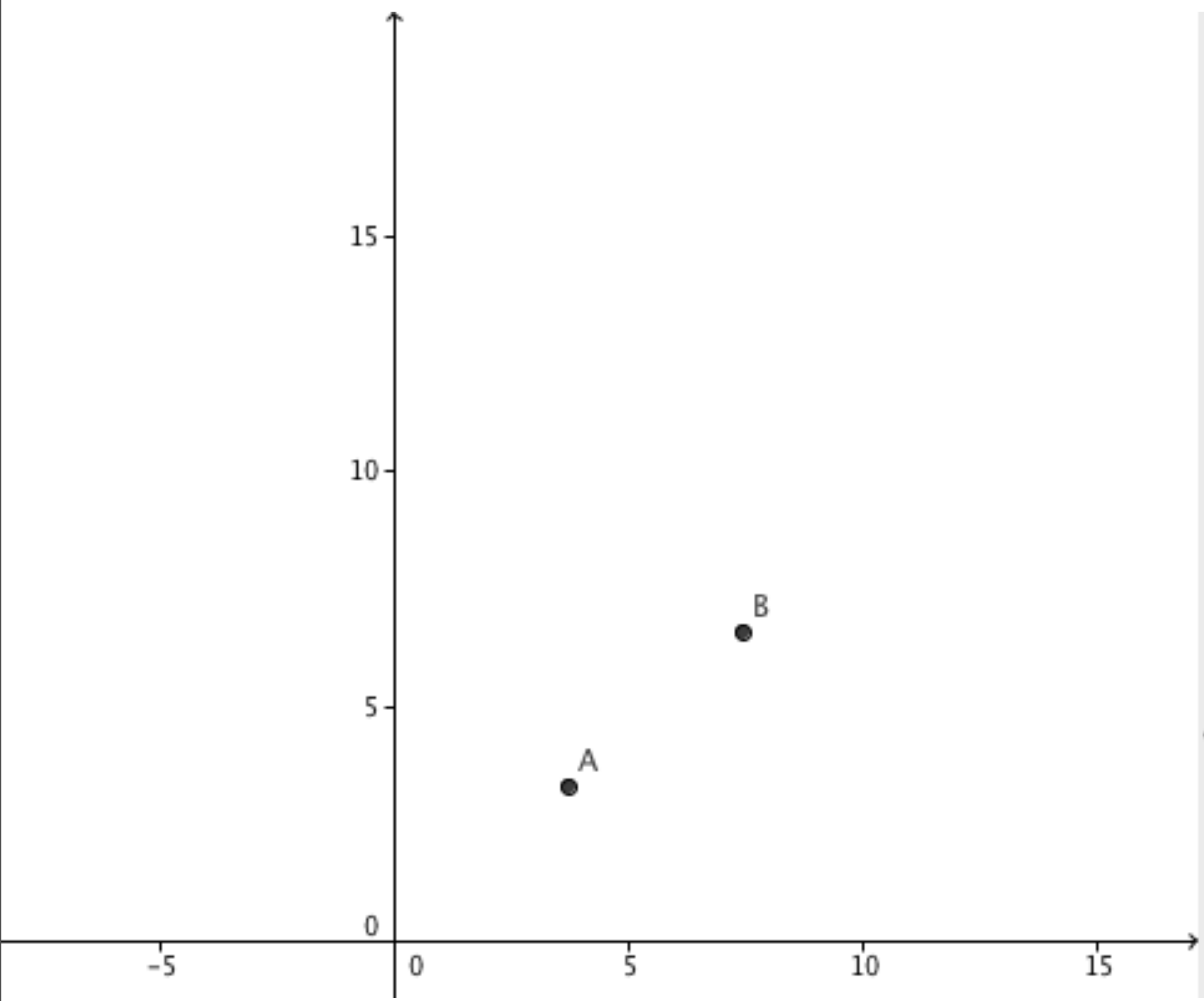
How can the dynamic of the DGS help for solving this task?	Problems	Questions to ask my partner

2. Pair phase: Work with your partner.

1. Explain your partner your results and talk about problems and questions.
2. Use the prepared GeoGebra file with the possibility to define a matrix in spreadsheet mode.
3. Modify the given matrix and vectors using your results.
4. Note your verified results in a structured way and add steps for solving this problem.
5. Now use the answers you found out and the dynamic of DGS to find a suitable matrix for a rotation with a given angle $\alpha \in (0°, 360°]$

Thing about trigonometric mappings.



	A	B	C	D	E	F
1	Matrix			Vector		Result
2	1	1		3.7		7.4
3	1	1		3.3		6.61
4						
5						
6						
7						
8						
9						
10						
11						
12						
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14						
15						
16						
17						
18						

3. Share Phase: Present your results using the DGS. Explain your proceeding. Talk about difficulties and how you solved them.

Conclusion

1. The structure of cooperative learning concepts can give the work with DGS or digital tools in general in group or partner situations a framework, in which there has to be an individual thinking and working phase with regard on or in preparation for the work with the DGS.

2. This can have positive effects on the learning process having a situation of interdependency and responsibility of every individual.

3. The tasks and the structure of every step must be planed very well to get individual activation in the coherence of using digital tools.

Vielen Dank für Ihre Aufmerksamkeit

Хвала на пажњи

Hvala na pažnji